CHAPTER III
MARKET ANALYSIS OF FLOW CONTROLS

INTRODUCTION

The purpose of this Chapter is to present the research and analysis EPA conducted on solid waste management capacity and recycling and their relationship to flow controls. There are many variables and confounding factors that must taken into account when answering the questions posed by Congress. The Chapter starts with a discussion of why EPA c market analysis approach and the methodology EPA applied. This market analysis highlights current market conditions and dynamics in order to assess whether flow controls appear necessary to ensure adequate waste management capacity and tc promote recycling efforts. The Chapter also reviews other organizational and financial mechanisms that communities can u meet these same objectives.

To report to Congress in a systematic and comprehensive way on the impact of flow controls on State and local capacity and recycling/source reduction would require answers to questions such as the following:

> *Are **States** and **local governments** that authorize flow controls more likely to have adequate waste management capacity than **States** and **local governments** that do not authorize flow controls?*
>
> *Are **States** and **local governments** that authorize flow controls more likely to achieve **State** and/or **local goals** for source reduction, reuse, and recycling than **States** and **local governments** that do not authorize flow controls?*

Answering these questions would require substantial data -- much of it not readily available -- and the development new analytical and performance measurement methodologies. Each question poses distinct analytical challenges. For exam although available data indicate which States authorize flow controls, there is no systematic data on which of over 3,000 cc and 19,000 municipalities actually employ flow controls. Collecting such data would entail a major research effort to deterr which communities impose flow controls, whether those flow controls cover mixed waste only or include recyclables, and whether there are exemptions for established recycling programs, construction and demolition debris (C&D) wastes, or oth special scenarios. A comparative analysis of communities with and without flow controls also would require data on all inv parties including waste haulers, waste management facilities, State and local governments, and residential, commercial, institutional, and industrial generators of MSW. The analysis of how flow controls affect waste management capacity wou need to consider and adjust for differences in quantities and types of waste generated as well as in the underlying financial resources of States and local governments, which can affect how they arrange for capacity.

Similarly, an empirical analysis of how flow controls impact progress towards goals for source reduction, reuse, a recycling must consider not only (1) State and local waste generation and financial resources, which can strongly affect lev program activities to encourage source reduction, reuse, and recycling but also (2) how the goals are defined and what tar chosen. Some States and local governments have set more ambitious goals than others. Achievement of the goals may be matter of variables such as demographics, the local economy, and how high the goals are set than a reflection of the use of

Another complicating factor is that State and local governments have alternative ways of accomplishing the same results as flow controls can produce. These include the following:

- providing collection services, either directly by local government employees or through contractors, to deliver the wastes and materials to designated facilities;
- awarding collection and hauling franchises that require waste to be taken to designated facilities;
- subsidizing the tipping fees at selected facilities to attract sufficient waste; and
- supporting solid waste programs using funds raised through taxes, issuance of bonds, and/or user fees, such as variable rate charges, imposed on generators.

Thus, flow controls may be unnecessary for jurisdictions that directly perform or contract for waste collection and hauling themselves. The existence and use of alternatives to flow controls that achieve the same goals substantially compli the analysis, making it more difficult to isolate the effects of flow controls.

Even a case study approach, which would not attempt to answer the above questions for every State and locality, would require a sophisticated sampling methodology for selecting cases (i.e., jurisdictions with flow controls) and controls jurisdictions without flow controls) for unbiased analysis, given the potentially confounding factors described above.

Because the findings could differ across States and localities (e.g., flow controls may help some States and local governments, but not others), EPA would need to develop a methodology for weighting the findings across States and loca governments and testing the statistical significance of the results.

The data and methodological challenges are accentuated by the rapid pace of change in this area. Not only do the amounts of waste generated change, but so do the technologies, programs, and goals for managing and recycling the waste and local governments vary in the types of programs they pursue and the pace of program evolution. This dynamic contex lack of data call for a different type of analysis.

After considering the requirements of a data-intensive "bottom-up" micro-level analysis, EPA evaluated an alternativ approach: a "top-down" macro-level analysis of the waste management market. The focus of this type of analysis is to as whether market forces overall appear capable of providing an adequate and environmentally sound infrastructure for solid w management or whether market intervention in the form of flow controls is needed to ensure adequate capacity or achieve recycling goals. EPA chose to conduct this type of market analysis.

THE MARKET ANALYSIS

This study recognizes discrete market segments that both work together and compete to perform the complete job solid waste management in communities. These segments include:

- composting (i.e., yard trimmings composting, mixed waste composting);
- recycling (i.e., materials recovery facilities (MRFs) for commingled recyclables, mixed waste processing facilities (MWPFs) that extract recyclables from mixed waste, paper packers and buy-back/drop-off centers for recyclables);
- combustion (i.e., waste-to-energy (WTE) conversion, incineration without energy recovery); and
- landfills.

The study uses several indicators to assess market conditions and the prevalence of flow controls for these segme

- growth trends
- ownership patterns
- cost competitiveness, and
- capital requirements

Because these indicators are used throughout this chapter, each one is briefly described in the following paragraph related back to the central topics of this Report to Congress.

Growth Trends. Growth in any waste management market serves as an indicator of its viability. Growth suggest there is an ample supply of waste input and that facilities may not need flow controls to guarantee an adequate waste suppl This indicator works particularly well for composting and recycling markets, both of which have grown significantly, large without depending on flow control; their growth also reflects State intervention in the form of establishing recycling goals landfill bans. On the other hand, the growth of the combustion (WTE) market largely reflects the use of flow controls or comparable waste guarantee arrangements to ensure sufficient revenues to cover debt service.

Ownership Patterns. The relative share of public and private ownership of waste management facilities also can se as an indicator of how well markets are working. Initially, the risks and uncertainties of new waste management methods discourage private sector participation; as a result, so-called "infant industry" may need special support, such as flow contr Once a new industry is demonstrated and established, private sector entrepreneurs may view the risk-reward ratio as more attractive. Thus, private sector ownership of waste management facilities can serve as an indicator of market development indicator works well for composting, recycling, and landfilling as a measure of the ability of the marketplace to provide ade capacity and help achieve recycling goals. This indicator does not work as well for WTE facilities; although many are priva owned, a large portion are supported by flow controls or may qualify as public-private partnerships where the public sector guarantees a supply of waste sufficient to meet high utilization rates.

Cost Competitiveness. One way that government can support a desirable industry or facility is through subsidies other mechanisms (e.g., minority or small business set-asides, protection from competition) that enable it to prosper in the marketplace. Such support may be required for the foreseeable future (e.g., domestic shipbuilding) or only until the indust facility attains competitiveness. Once the industry becomes cost-competitive, the need for special support may diminish or vanish. In the waste management sector, cost-competitiveness is a good indicator that further government support may nc needed.

Capital Requirements. Capital-intensive industries have what are called "high barriers to entry." Even if the industr can compete in the marketplace in terms of its operating costs, the private sector may be deterred by the necessity to raise finance the capital costs needed at the start. Both magnitude and timing of capital requirements, therefore, can serve togetl an indicator of the ability of the marketplace to meet MSW needs without special government support. This indicator work very well for most segments of the MSW management market; capital requirements correlate well with use of flow contro example, low-technology composting and recycling have the lowest capital requirements and the least need for flow contro high-technology MRFs have greater up-front capital needs and make greater use of flow controls. WTE has the largest cap requirements and the greatest reliance on flow controls; the larger the facility, the more likely it is supported by flow contro Landfills can spread much of their capital requirements over time by opening cells on an as-needed basis, thus reducing the for flow controls.

LIMITS OF THE MARKET ANALYSIS

The above indicators have their limitations. But together the indicators serve to help describe the key segments of MSW market, their degree of flow control use, and their ability to provide adequate capacity. They are rough measures tha cannot capture the realities of every local MSW market but can provide a national overview to enable an assessment of the of flow controls in ensuring MSW management capacity and in attaining goals for source reduction, reuse, and recycling. market analysis provides a dynamic assessment of the competitive forces nationwide that affect MSW management capacit recycling rates over time. The role of flow controls is assessed in the context of these broad market dynamics. Data limita for the individual market segments are specified in greater detail at the beginning of Sections B, C, D, and E.

Source reduction as a market segment is not considered, because flow controls direct waste flows after waste gen (i.e., after the potential for source reduction). This Report recognizes, however, that source reduction or waste prevention help alleviate the need for additional disposal capacity in the future, much as the growth of recycling and composting does. Source reduction practices include eliminating and minimizing packaging, efficient use and reuse of products and supplies, procurement of products and packaging which result in less waste.

METHODOLOGY

EPA conducted its market analysis in three steps:

1. **Characterize the overall demand for MSW management services**. As a first step in the market analysis, EPA characterized waste generation that is relevant to the analysis of flow controls. Waste generation creates the demand for waste management services and defines the relevant market size for the analysis. The market size estimate provides a basis for determining the percentage "market share" attributable to each waste management service segment.

2. **Evaluate the supply of waste management services provided by the waste management industry (both public and private)**. After estimating the size of the relevant waste stream, EPA examined the role of four major market segments in managing this waste: composting, recycling, waste-to-energy (WTE), and landfills. EPA's analysis of each major market segment has four components:

   -- Overview of Growth Trends. The analysis of each market segment begins with a description of recent growth trends.

   -- Market Subsegments. This subsection describes the subsegments and their market shares.

   -- Market Segment Competitive Structure. This subsection examines the competitive factors that affect capacity and recycling rates. Key factors that compel or restrain market segment growth include competitive economics (cost comparison with other management options), capital requirements and required scale of operations, the influence of flow controls and other government initiatives (e.g., curbside recycling, yard trimmings landfill bans), and the extent of the public/private infrastructure available to support market segment expansion.

   -- Market Segment Potential. Finally, each market section ends with a discussion of the potential for that segment to provide additional waste management capacity, based on recent trends and the segment's competitive structure. With respect to recycling goals, the analysis of composting and recycling potential also examines the important role of end-markets for compost and recycled materials.

3. **Analyze current waste management market dynamics and recent market developments to evaluate impacts of flow controls**. As a final step, EPA used the findings of the market segment evaluations together with basic economic and financial principles to assess the impact of flow controls and the need for the use of flow controls to ensure adequate capacity and/or to achieve recycling goals.

OUTLINE OF REMAINDER OF CHAPTER

- **Section A** estimates the size of the waste stream managed at MSW facilities and defines these facilities. Supporting technical analyses and background information appear in Appendix III-A.

- **Sections B, C, D, and E** discuss the role of the composting, recycling, WTE, and landfill market segments, respectively, in managing the waste stream described in Section A. Each section examines the growth of the market segment over recent years, the subsegments that make up each market segment, the competitive structure of the market segment and its subsegments, and the potential growth of the market segment. Supporting technical analyses and background information comprise Appendices III-B, III-C, III-D, and III-E, respectively.

- **Section F** assesses the results of the market segment analysis to address Congress' questions concerning the impact of flow controls on ensuring adequate waste management capacity and promoting recycling goals.

- **Section G** reviews organizational and financial alternatives to the use of flow controls.

A. THE DEMAND FOR WASTE MANAGEMENT SERVICES

Waste generation is a critical element in assessing the adequacy of waste management capacity and in calculating recycling rates. Therefore, an appropriate definition and quantification of the relevant waste stream are essential foundations for the market analysis of flow controls. This section uses available data sources to estimate the size of the waste stream managed in MSW facilities. Appendix III-A contains the results of technical analyses used to prepare this section.

> The central issue of this market analysis is whether market forces are capable of providing an adequate and environmentally sound infrastructure for solid waste management, or whether market intervention in the form of flow controls is needed to ensure adequate capacity or achieve recycling goals.

A.1 AVAILABLE DATA ON WASTE STREAM

Two frequently cited data sources contain estimates of the relevant waste streams:

(1) ***Characterization of Municipal Solid Waste in the United States***. This is a biennial series of EPA reports that characterize MSW generation in the United States. The version used for this Report is the 1992 Update, which estimates 1990 waste generation.

(2) ***The State of Garbage in America***. This is an annual (since 1991) article published in *BioCycle* that compiles waste stream estimates collected from a survey of the 50 States and the District of Columbia. This Report uses the May 1993 article, which compiles 1992 waste stream estimates, as well as the 1991 article, which compiles data for 1990.

These two sources present different estimates of the size of the waste stream. *BioCycle's* 1990 waste stream estimate is approximately 294 million tons, while EPA's 1990 estimate is approximately 196 million tons, a difference of 98 million tons. The difference appears to reflect the fact that the amount of MSW *generated*, which EPA estimates, is less th the total amount of waste *handled* at MSW facilities, which *BioCycle* estimates.

A.2 METHODOLOGY USED TO ESTIMATE MARKET SIZE

Market Definition

In order to assess the need for flow controls to ensure adequate MSW management capacity and recycling, this an defines the MSW management market to include (1) all facilities receiving MSW ("MSW facilities") and (2) all non-MSW (defined below) that is managed at MSW facilities, since this non-MSW competes for available MSW management capacity This definition does not include facilities, such as industrial waste landfills, that receive only specific types of waste exclude from EPA's definition of MSW.

Using three steps, EPA analyzed available data to determine the best estimate of total MSW and non-MSW manage MSW facilities:

1. **Examine the different estimation methodologies used by *BioCycle* and by EPA's *Characterization of Municipal Solid Waste in the United States*.** This examination indicates that non-MSW wastes account for most of the difference in waste estimates.

2. **Compare EPA and *BioCycle* 1990 estimates by market segment.** This comparison indicates that the landfill market segment accounts for virtually all of the difference between these two estimates.

3. **Compare *BioCycle* landfill estimates with available State data.** This comparison confirms that the *BioCycle* waste estimates generally include non-MSW wastes managed at MSW landfills and exclude non-MSW wastes managed at separate non-MSW landfills, which is consistent with the approach used in this Report.

Examination of Methodologies

EPA's Estimation Methodology. EPA's biennial update uses a materials flow methodology to estimate MSW generation nationwide. This methodology is based on production data (by weight) as provided by the U.S. Department of Commerce and trade associations, where available, for materials and products that end up in the municipal waste stream. E adjusts these production data to account for imports and exports, for diversions from the MSW waste stream (e.g., for bui materials made of paperboard that eventually become construction and demolition waste), and for the lifetimes of products. Finally, EPA uses waste sampling data to develop estimates for food wastes, yard trimmings, and other wastes for which production data are unavailable. EPA adjusts the sampling data to take into account moisture transferred from food and yar trimmings to other materials in the waste stream. The result is a material-by-material and product-by-product estimate of M generation nationwide. EPA's estimate is useful to this market analysis of flow controls in two ways:

1. **Estimates MSW generation only**. EPA defines MSW to include "wastes such as durable goods, nondurable goods, containers and packaging, food scraps, yard trimmings, and miscellaneous inorganic wastes from residential, commercial, institutional, and industrial sources. Examples of waste from these categories include appliances, newspapers, clothing, boxes, disposable tableware, office and classroom paper, wood pallets, and cafeteria wastes. MSW does not include wastes from other sources, such as construction and demolition (C&D) waste, municipal sludges, combustion ash, and industrial process wastes that might also be disposed of in municipal waste landfills or incinerators."[1] EPA's estimate of waste generation is an estimate of the generation of EPA-defined MSW only. Wastes excluded from EPA's definition of MSW are referred to as "non-MSW" in this Report.

2. **Facilitates calculations of recycling rates and assessments of the waste management infrastructure**. EPA's estimates of MSW generation, which are developed by material type (paper, glass, etc.) with additional detail within each material type (e.g., containers versus durables, different grades of paper and paperboard), can facilitate the calculation of recycling rates by product and material types. Understanding MSW generation by material type also can be important when assessing the adequacy of the waste management infrastructure, because different materials and products may be handled more easily and/or economically by different types of facilities.

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[1] "Characterization of Municipal Solid Waste in the United States: 1992 Update," EPA, July 1992, p. ES-2.

With respect to this market analysis, however, EPA's estimate does not include non-MSW that is co-managed with MSW in MSW facilities, such as sanitary landfills.

<u>*BioCycle's* Estimation Methodology</u>. In preparing its annual survey, *BioCycle* asks each State to (1) estimate the amount of MSW generation in the State; (2) divide this estimate into commercial, residential, and industrial segments; and (describe the source of the data.[2] In practice, however, *BioCycle* finds that States do not always provide an estimate of MS generation only. Rather, States may include non-MSW in their generation estimates and/or report the total amount of waste (MSW and non-MSW) received at MSW facilities, instead of the amount of MSW generated.[3] *BioCycle* footnotes confirm that many States include substantial amounts of non-MSW in their reported waste totals. However, not all States distinguis between MSW and non-MSW when reporting to *BioCycle*, and some States do not appear to make this distinction on a consistent basis from year to year.[4]

Because of this approach, the *BioCycle* methodology covers more waste than is included in EPA's definition of MSW. Nevertheless, the *BioCycle* approach benefits this analysis of flow controls by measuring additional non-MSW that may affect State MSW management capacity.

Comparison of EPA and *BioCycle* 1990 Estimates by Market Segment

Exhibit III-1 compares EPA and *BioCycle* 1990 waste estimates by management method (i.e., recycling/compostir landfill, and combustion) to illustrate which market segments account for the difference in waste estimates provided by the data sources. As this exhibit shows, the landfill market segment accounts for almost the entire difference between the two estimates.

EXHIBIT III-1
EPA and *BioCycle* 1990 Waste Estimates by Management Method

[2] Conversation with Mr. Bob Steuteville, *BioCycle*, May 4, 1994.

[3] "The State of Garbage in America," *BioCycle*, May 1993, page 42 and telephone conversation with Robert Steuteville, May 4, 1994.

[4] This inconsistency is illustrated by waste generation estimates for the State of Alabama from 1990 to 1992. In 1990, the State reported a waste generation amount of 4.4 million tons, which *BioCycle* noted included "some [C&D] and industrial waste." In 1991, Alabama reported waste generation of 4.5 million tons, which *BioCycle* noted to include "C&D, industrial, and sewage sludge." In 1992, Alabama reported waste generation of 5.2 million tons, but *BioCycle* noted no non-MSW inclusions. Based on the 1990 and 1991 data, however, it appears that non-MSW also was included in the 1992 estimate, because Alabama reported a substantial increase in waste generation in 1992 (relative to 1991), and the 1991 estimate included non-MSW wastes.

Contains Data for

Postscript Only.

BioCycle reported that 226 million tons of waste were landfilled in 1990, while EPA estimated 130 million tons of MSW landfilled. The difference in these estimates (96 million tons) is nearly equal to the difference (98 million tons) in the size of the waste stream reported by the two data sources in 1990. This suggests that many States provide *BioCycle* with estimates of the total amount of waste received at MSW landfills, not just the amount of MSW received. In contrast, both sources present similar estimates for the amount of waste composted/recycled and combusted;[5] such facilities do not typica receive much non-MSW.

[5] The difference in estimates for composting/recycling (35 million for *BioCycle* and 33 million for EPA) could be due to rounding error.

Comparison of *BioCycle* Landfill Estimates with Available State Data

Because non-MSW managed at MSW facilities affects remaining MSW management capacity, EPA contacted each the 50 States to request available data on waste generation and MSW management methods to confirm whether non-MSW reported in *BioCycle* was managed at MSW facilities or at non-MSW facilities (e.g., C&D landfills). The results of this analysis appear in Exhibit III-A.1 in Appendix A. Although most States were unable to provide necessary data, a limited number of States supplied data EPA could use. Based on this data, EPA determined that the amount of waste reported to *BioCycle* as landfilled is very close to the actual amount of waste received at MSW landfills. Therefore, EPA concluded that the *BioCycle* data provides the best available estimate of MSW and non-MSW received at MSW landfills nationwide.

A.3 1992 ESTIMATE OF WASTE RECEIVED AT MSW FACILITIES

BioCycle reports that MSW facilities in 1992 received approximately 292 million tons of MSW and non-MSW.[6] For comparability, Exhibit III-2 adjusts EPA's 1990 MSW estimate of 196 million tons, a per capita generation rate of 4.3 pounds per day, by the percent change in population to arrive at a tonnage estimate for 1992.[7] In total, EPA's population-adjusted 1992 MSW generation estimate equals approximately 200 million tons. As discussed above, EPA believes that the difference between the EPA and *BioCycle* estimates is non-MSW that is managed in MSW landfills.

A.4 1992 ESTIMATE BY WASTE MANAGEMENT METHOD

Exhibit III-3 shows how the 292 million tons of waste were managed in 1992 by the four management methods: composting, recycling, waste-to-energy, and landfill. (Appendices III-B, III-C, III-D, and III-E detail the bases for these estimates.) As the exhibit indicates, EPA believes that all the waste that was composted, recycled, and combusted in WTE facilities was primarily EPA-defined MSW, while nearly one-half of the waste landfilled was non-MSW.

EXHIBIT III-2

EPA Estimate of Municipal Solid Waste (MSW) Generation in 1992 by Material Type

EPA MSW Material Type	EPA-Reported Tons Per Capita (1990)	Population-Adjusted Estimate (1992, million tons)
Paper and Paperboard	0.295	75.3
Glass	0.053	13.5

[6] *BioCycle's* 1994 annual survey (reporting 1993 data) was not available at the time this analysis was prepared.

[7] EPA's 1994 Update of MSW in the U.S. (with 1993 data) was not available in time for this Report. Exhibit III-2 lists the 1990 per capita generation rates by material type and uses a 1992 population of 255,082,000. This population-adjusted amount does not consider changes in per capita generation rates, only changes in population.

Metals	0.065	16.6
Plastics	0.065	16.6
Rubber and Leather	0.018	4.6
Textiles	0.023	5.9
Wood Waste	0.049	12.5
Food Waste	0.053	13.5
Yard Trimmings	0.141	36.0
Other Waste[a]	0.025	6.4
Total EPA-Defined MSW Generation	**0.787**	**200.0**[b]

[a] "Other Waste" includes the EPA MSW categories of "other products" and "miscellaneous inorganics."
[b] Numbers do not add to 200 due to rounding.

EXHIBIT III-3

Management of 1992 Waste Stream by Market Segment

Contains Data for

Postscript Only.

To summarize, EPA estimates that in 1992, 292 million tons of waste were managed in MSW facilities. Of this amount, 9 million tons were composted, 40 million tons were recycled, and 32 million tons were combusted. EPA further estimates that virtually all of the waste managed in these three market segments was EPA-defined MSW. The remaining w 211 million tons, of which 92 million tons were non-MSW, was disposed in MSW landfills. The next four sections discuss dynamics of each of these four market segments.

B. COMPOSTING MARKET SEGMENT

Key Findings

- Composting has expanded rapidly over recent years to become a significant MSW market segment, accounting for approximately 9 million tons of waste received at MSW management facilities in 1992.
- Yard trimmings composting accounts for approximately 96 percent of the 9 million tons of waste managed by the compost market segment, with mixed waste composting accounting for the remaining 4 percent of this market segment.
- Yard trimmings landfill bans, adopted by 27 States as of July 1993, have played a significant role in accelerating the growth of yard trimmings composting.[8]
- In some communities, the cost of yard trimmings collection and composting is competitive with the cost of mixed waste collection and disposal in landfills and WTEs; mixed waste composting, on the other hand, entails significantly higher costs that may make this market subsegment less competitive with landfill disposal.
- Limited data on public sector versus private sector composting indicate that a variety of private firms are playing a significant and expanding role in this market segment; these firms can provide an infrastructure of technical and managerial resources for communities that do not wish to own and/or operate composting facilities.
- The use of flow controls to direct yard trimmings to specific composting facilities has not been found to be a common practice or a significant factor affecting the growth of this market segment.
- The compost market segment should be capable of ensuring additional MSW management capacity based on recent growth, an expanding number of States with yard trimmings landfill bans, and an ample supply of compostable waste.

Data Limitations

Appendix III-B presents available data on the amount of waste managed by the compost segment. Although detaile data are available for mixed waste composting facilities, data are limited on the amount of waste managed by yard trimming composting facilities. EPA's estimate of yard trimmings composting in 1992 is based on an analysis of available State data throughput of yard trimmings composting facilities and *BioCycle's* data on the total number of such facilities.

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[8] "Yard Waste Legislation: Disposal Bans and Similar Passed Bills as of July, 1993" (Composting Council Fact Sheet).

EPA has identified no compilation of data on use of flow controls by composting facilities. Although anecdotal dat confirm that flow controls are used to guarantee waste flows for at least some mixed waste composting facilities, EPA has no evidence that flow controls are used widely for yard trimmings composting facilities. Many States that authorize flow controls for mixed waste explicitly exclude recyclables such as yard trimmings from flow controls.

B.1 OVERVIEW OF GROWTH TRENDS

Over the past several years, composting facilities have expanded from a negligible role in MSW management to a significant market segment. The composting market segment managed approximately 9 million tons of waste in 1992 (as explained in Appendix III-B). In EPA's *Characterization of Municipal Solid Waste in the United States: 1990 Update*, the Agency estimated that only 0.5 million tons of MSW were composted in 1988. In the Agency's *1992 Update*, EPA estimated that 4 million tons of MSW were composted in 1990 and projected that the amount of MSW composted would reach approximately 11 million tons by 1995. Exhibit III-4 shows this trend line, together with this Repo estimate of 9 million tons for 1992.

The main impetus for this growth in composting has been the substantial increase in the number of States that hav adopted yard trimming landfill bans. This has led to significant growth in the number of yard trimmings composting faciliti which account for approximately 96 percent of all MSW composted. Exhibit III-5 shows that the number of yard trimmin composting facilities in the U.S., as reported by *BioCycle*, has increased nearly five-fold from 651 in 1989 to 3,100 in 1993

EXHIBIT III-4

Estimated Growth in Composting Market Segment

Contains Data for

Postscript Only.

EXHIBIT III-5

Growth in Number of Yard Trimmings Composting Facilities (1989 to 1993)

Contains Data for

Postscript Only.

B.2 MARKET SUBSEGMENTS

Exhibit III-6 divides the composting market segment into the following two market subsegments:

EXHIBIT III-6

Composting Market Subsegments
(1992)

Contains Data for

Postscript Only.

- **Yard Trimmings Composting**. As of 1992, *BioCycle* reported 2,981 yard trimmings composting facilities in operation in the U.S. Together these facilities managed 96 percent of the 9 million tons of MSW composted in 1992. (See Appendix III-B for estimates.) For 1993, *BioCycle* reported 3,100 composting facilities.

- **Mixed Waste Composting**. As of 1992, 21 mixed waste composting facilities were operational, although several were temporarily shut down for repairs or other problems. Together these facilities managed approximately 4 percent of the 9 million tons of MSW managed by the composting market segment in 1992 (see Appendix III-B for estimates).[9]

B.3 MARKET SEGMENT COMPETITIVE STRUCTURE

[9] The estimate for mixed-waste composting includes two facilities that actually receive a source-separated feedstock of food waste, soiled paper, corrugated cardboard, and other commingled compostables, as opposed to completely mixed solid waste (requiring the separation and removal of non-compostables). The waste processed by source-separated organics composting appears to have been negligible in 1992, but this type of composting may constitute another distinct and significant market subsegment in future years. The potential for source-separated organics composting is being assessed by a number of pilot plants and demonstration projects underway, sponsored by organizations as diverse as the Composting Council, the National Audubon Society, the Grocery Manufacturers of America, and the Food Marketing Institute. ("Composting Collection," *Waste Age*, July 1993.)

The explosive growth in the composting market segment is driven by at least four separate factors:

1. A large and increasing number of States and the District of Columbia have banned the landfill disposal of yard trimmings (27 States by 1993).[10]

2. Even in the absence of landfill bans, yard trimmings composting is an economical alternative to landfill disposal and combustion in some communities.

3. Yard trimmings composting can effectively employ existing waste management equipment (e.g., packer trucks) and can operate efficiently on a relatively small scale, allowing for the incremental expansion of composting activity without the risk of substantial capital investments for new facilities.

4. There is an expanding universe of private firms providing compost facility design, operation, and management services for local governments, which may facilitate composting activities in communities that do not wish to own and/or operate their own composting facilities.

Flow controls have not been identified as a significant factor for composting facilities, as discussed below.

Yard Trimmings Landfill and Combustion Bans

Twenty-seven (27) States had adopted bans on the landfill disposal of yard trimmings as of July, 1993,[11] and many these States also banned yard trimmings from combustion in WTE facilities and incinerators.[12] Such bans may be describe "flow constraints," because they constrain the extent to which yard trimmings composting facilities must compete with oth MSW market segments, essentially limiting yard trimmings management to a competition among different composting facili and source reduction (e.g., backyard composting, the use of mulching lawnmowers). While flow controls require that cert wastes and materials be directed to particular management facilities, eliminating the competitive forces that may encourage efficiency, bans eliminate only certain types of competition (e.g., landfill disposal) but still allow waste generators and wast haulers to direct wastes to the facility of their choice.

Competitive Economics

Although landfill and combustion bans have accelerated yard trimmings composting trends, economic factors also support the growth of this market segment. Available data on yard trimmings composting costs versus landfill costs, for example, indicate that yard trimmings composting is an economical alternative to land disposal in some communities. Exhil 7 presents recent data on the

[10] "Yard Waste Legislation: Disposal Bans and Similar Passed Bills as of July, 1993" (Composting Council Fact Sheet).

[11] "Yard Waste Legislation: Disposal Bans and Similar Passed Bills as of July, 1993" (Composting Council Fact Sheet).

[12] "Solid Waste Legislation: The State of Garbage in America," *BioCycle*, June 1993.

EXHIBIT III-7

Yard Trimmings Collection and Composting Costs Versus Mixed Waste Collection and Disposal Costs

Community	Percent Yard Trimmings Recovered	Yard Trimmings Collection & Composting Cost Per Ton ($)	Mixed Waste Collection and Disposal Cost Per Ton ($)	Cost Advantage (Disadvantage) Per Ton ($)
Berlin Township, NJ	39	$10	$108	$98
King County, WA	7	96	107	11
Lafayette, LA	6	109	62	(47)
Lincoln Park, NJ	31	23	173	150
Naperville, IL	13	106	111	5
Perkasie, PA	21	39	113	74
Takoma Park, MD	18	90	132	42
West Linn, OR	N/A	40	144	104
West Palm Beach, FL	18	63	102	39

cost of yard trimmings collection and composting versus mixed waste collection and disposal costs in nine communities ac the country.[13]

In 8 of these 9 communities, yard trimmings collection and composting costs range from $5 to $150 per ton less t mixed waste collection and disposal. The one community where yard trimmings composting reportedly is more expensive landfill disposal is located in Louisiana, where landfill tipping fees average a mere $15 per ton, according to *BioCycle*. Aver landfill tipping fees in the other States shown in Exhibit III-7 range from $40 to $74 per ton. Most yard trimmings compos distributed to users without charge,[14] and the cost comparisons in Exhibit III-7 indicate that most of these communities do need compost revenues to make composting economical.

Exhibit III-7 also indicates a strong inverse correlation between the percentage of yard trimmings recovered and th average cost per ton for collection and composting. For example, the three communities with recovery rates between 6 an percent incur costs between $96 and $109 per ton. Conversely, the two communities with recovery rates above 30 percen report costs of just $10 and $23 per ton; although these low costs raise questions about whether the full costs of collection

[13] In-Depth Studies of Recycling and Composting Programs, Institute for Local Self-Reliance; and reported in "The Cost Effectiveness of Yard Debris Recovery," *Resource Recycling*, April 1993.

[14] "A Database On Composting Facilities: A Progress Report," *Resource Recycling*, December 1992.

included above, the point is that higher participation rates from residents can spread the fixed costs of yard trimmings collection and composting and reduce the average cost per ton.

EXHIBIT III-8

Average Cost and Capacity of Compost Facilities

Facility Type	Operating Cost/Ton	Total Capital Cost	Design Capacity (tpd)
Yard Trimmings	$30	$43,296	70
Mixed Waste	$59.50	$12,286,000	201

Exhibit III-8 presents data on the average operating and capital costs and design capacity (tons per day) for yard trimmings and mixed waste composting facilities.[15] The yard trimmings composting capital costs in Exhibit III-8 may understate the actual capital requirements for the design capacities shown, because these are average values based on reported data an not reflect a rigorous cost analysis. The composting of yard trimmings can be accomplished with low-cost technology or investment in high-cost equipment. Higher technology yard trimmings facilities may require capital investments of $2,000 t $12,000 per ton of daily processing capacity, equivalent to $140,000 to $840,000 total capital cost for 70 tons per day desi capacity.[16] The capital cost estimates shown in Exhibit III-8 appear to reflect the predominance of low technology yard trimmings composting nationwide. Also, the cost estimates reported by many communities may not reflect a detailed accou for the full costs of their composting operations.

Although the cost estimates in Exhibit III-8 do not represent a rigorous cost analysis for any single type of compos facility, a comparison of the costs reported for different types of facilities clearly indicates that mixed waste composting is substantially more expensive than yard trimmings composting. Furthermore, at $59 per ton, the average operating cost alo mixed waste composting is higher than the average tipping fee for landfill disposal reported by *BioCycle*[17] for 46 States.

Capital Requirements and Scale of Operations

Exhibit III-8 also illustrates that mixed waste composting requires a large capital investment, entailing greater finan risk, which constitutes another competitive disadvantage for this market subsegment. Yard trimmings composting facilities contrast, do not require substantial initial capital investments.

Low technology yard trimmings facilities may require only the placing of yard trimmings in piles or windrows and turning them. This process generally requires at least one year to produce mature compost.

Higher technology facilities may be appropriate for urban or suburban communities with limited space and large quantities of yard trimmings. Higher technology yard trimmings facilities require capital investments for equipment to grin

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15 "A Database On Composting Facilities: A Progress Report," *Resource Recycling*, December 1992.

16 "The Cost Effectiveness Of Yard Debris Recovery," *Resource Recycling*, April 1993.

17 Robert Steuteville and Nora Goldstein, "1993 Nationwide Survey: The State of Garbage in America," *BioCycle*, May 1993.

shred, or screen yard trimmings prior to putting them in windrows, plus equipment for turning and mixing windrows more frequently, as well as sheds for curing the compost to maturity. This type of active management program reduces the pote for odor generation, produces very low residuals for disposal (i.e., approximately two percent of waste received), and redu composting process to less than eight months.

The variety of cost-effective yard trimmings composting technologies makes the investment in composting faciliti viable alternative to landfilling for many communities. Communities can conduct cost-effective yard trimmings collection v existing packer trucks, although many communities use leaf-vacuum trucks or other specialized collection equipment. Sma municipalities can use citizen drop-off systems. The ability to leverage existing collection equipment and the limited capital investment required for low technology yard trimmings composting facilities also reduce the lead time required for the expa of composting activities. In summary, the range of facility and collection options allows communities to make incremental investments in yard trimmings composting programs without assuming substantial financial risk.

Public/Private Infrastructure

Although State and local governments have taken the lead in expanding the composting market segment, the Composting Council estimates that one-third of composting facilities are now owned and/or operated by private firms.[18] Tl limited amount of available data on public versus private activity in this market segment confirms that the private sector is expanding the infrastructure of technical and managerial resources available for composting:

- Private firms account for 31 percent of yard trimmings composting in the State of Florida;
- Privately-owned facilities account for 11 of the 17 composting facilities reported by the State of Washington;
- One firm in New York, specializing in the design and management of municipal, commercial, and industrial composting programs, now manages over 50 sites throughout the Northeastern U.S. and Canada;[19]
- The combined throughput of private facilities operated by four sludge composting firms in New England accounts for 40 percent of the total sludge composted in the region;[20]
- Several small waste firms are now investing in low-capital-cost food composting facilities, targeting source-separated organics from grocery stores, restaurants, educational institutions, prisons, hospitals, and large food processing companies;[21] and

[18] Conversation with Randy Monk, Director of Operations for the Composting Council, March 21, 1994.

[19] "Private-Public Partnership Proves Profitable for Regional Processing of Yard Trimmings," *Resource Recycling*, April 1992.

[20] "Compost Marketing in New England," *BioCycle*, August 1993.

[21] "Composting Collection," *Waste Age*, July 1993.

- Most of the firms involved in contract operations for sludge, yard trimmings, and mixed waste composting facilities typically supply part or all of the facility design and required equipment.[22]

The expanding infrastructure of private sector composting services may facilitate the growth of this market segme communities reluctant to assume the program or facility management risks associated with new methods of waste manage

Flow Controls and MSW Composting

Unlike certain other MSW market segments such as MRFs and WTEs, data on the use of flow controls by compos facilities are not available; therefore, EPA reviewed a wide range of literature to identify anecdotal reports or indicators of fl control use. In all of the literature reviewed for this analysis, EPA has not identified any references to yard trimmings composting facilities subject to flow controls. Furthermore, *BioCycle* (April 1994 "State of Garbage") reported that New Jersey has just recently updated its list of yard trimmings composting facilities and found that many facilities had consolida into larger composting facilities. Similar trends also have been found in other State (e.g., Indiana) reports. Such consolidat would not be occurring at such rates if yard trimmings composting facilities were being supported by flow controls; rather market forces are encouraging consolidation of composting facilities to achieve greater economies of scale, and thereby lov costs and prices.

There were only 21 mixed waste composting facilities operating in 1992. Although complete data on their use of f controls is unavailable, some of these mixed waste facilities appear to use flow controls. One facility was the subject of a court case on flow controls, and 6 of these 21 facilities charge tipping fees of more than $80 per ton,[24] which is not cost-competitive with other disposal alternatives, indicating support by flow controls.

EXHIBIT III-9

Current Supply and Composting of Municipal Solid Waste (MSW) (million tons)

Waste Type	Amount Generated (1992)	Amount Composted (1992)
Paper & Paperboard	75.3	0.4
Food Waste	13.5	
Wood Waste	12.5	
Yard Trimmings	36.0	8.8
Total MSW	**137.3**	**9.2**

B.4 MARKET SEGMENT POTENTIAL

The potential size of the composting market segment is subject to two constraints: (1) the supply of compostable waste; and, (2) the end-market demand for compost.

[22] "Contract Operations for Composting Facilities," *BioCycle*, April 1993.

[23] "When Privatization Makes Sense," *BioCycle*, July 1992.

[24] *U.S. Solid Waste Composting Facility Profiles*, Vol. II, U.S. Conference of Mayors, March 1993.

Supply of Compostable Waste

The major compostable components of MSW are paper and paperboard, food waste, wood waste, and yard trimm Exhibit III-9 presents estimates for 1992 generation of these compostable materials and the current amount of each type be composted.

The generation estimates in Exhibit III-9 are derived from multiplying EPA's 1990 estimate of per capita generation these material types by the 1992 population (see Exhibit III-2 in Section A). The estimates of the amount of waste compos in 1992 reflect the Agency's estimate of 8.8 million tons of composted yard trimmings and 0.4 million tons of composted m waste.[25]

The ample supply of compostable waste indicates that it is theoretically feasible for this market segment to substantially expand its capacity for MSW management. The growing number of States with yard trimmings disposal bans States in 1993) and the favorable economics of this market subsegment support the continued growth of yard trimmings composting. There is also significant growth potential for source-separated organics composting. Residential participation for source-separated organics collection have ranged from 60 to 95 percent of households served by pilot programs and demonstration projects.[26] Commercial waste generators also could provide a large supply of source-separated organics. Fo example, the Grocery Industry Committee on Solid Waste estimates that six million tons of compostable food and paper wa are generated each year by grocery stores alone.[27]

End-Market Demand for Compost

Although the supply of compostable waste is ample, the end-market demand for compost is uncertain, even for compost that is available free of charge. A recent study by Battelle estimates that there is substantial potential for expandin end-markets for compost far in excess of the available supply of compostable waste.[28] However, although Battelle estimate that agriculture markets account for almost 90 percent of this potential demand, it is not clear to EPA whether a substantial expansion of agricultural demand is economically viable due to the cost of transporting and spreading compost.

End-market observations reported by other sources include the following:

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[25] EPA's 1994 Update of MSW in the U.S. (with 1993 data) was not finalized in time for use in this Report.

[26] "Pulling Compostables from the Waste Stream," *BioCycle*, May 1993.

[27] "Composting Collection," *Waste Age*, July 1993.

[28] "Compost Supply and Demand," *BioCycle*, January 1993.

- Many communities report that residents and other consumers are willing to take yard trimmings compost when it is distributed at no charge;[29]

- One composting facility in New England reports that it charges $15 per cubic yard for its compost, but the average price received by facilities that use brokers is $0.50 per cubic yard; one facility pays a broker up to $1.50 per cubic yard to find end users more than 45 miles away from the composting facility;[30]

- Two mixed waste composting facilities in Minnesota use their compost as alternative daily cover at landfills, even though they have contracts with tree farms willing to take the compost, because the cost of hauling the compost to the tree farms and spreading the material is too expensive;[31] and

- Use of compost for pollution control (e.g., wetlands restoration, biofilters, site remediation) is in the preliminary research phase.

Finally, State and local governments can and are taking a variety of actions to expand end-market demand for com by establishing procurement policies that favor the purchase of compost for public landscape and park maintenance uses. Similarly, EPA published in April 1994 a Comprehensive Procurement Guideline (CPG) which includes yard trimming com among 21 items designated; once the CPG is finalized, procuring agencies (including federal agencies, State and local agenc using federal funds, and their contractors) will be required to develop affirmative procurement practices for yard trimmings compost. This could increase demand substantially.

C. RECYCLING MARKET SEGMENT

Key Findings

- Recycling has expanded rapidly over recent years to account for approximately 40 million tons of all waste received at MSW management facilities in 1992.

- Private sector paper and paperboard recyclers account for 62.5 percent of this market segment, with buy-back and drop-off programs accounting for 22.5 percent, material recovery facilities (MRFs) 14.3 percent, and mixed waste processing facilities (MWPFs) less than 1 percent.

- Flow control has been an important factor for MRFs, particularly MRFs that require substantial capital investments.

- In 1992, 13 percent of MRFs (26 facilities) with 19 percent of total MRF throughput (close to 1.1 million tons) received waste guaranteed by flow control. This represents 2.7 percent of the 40 million tons of MSW recycled in 1992. MRFs operating under contractual agreements represent an additional 41 percent (81 facilities) with 44 percent of total MRF throughput (approximately 2.5 million tons). Some of these contracts may be supported by flow control.

- Low-technology MRFs and other recycling activities generally can be initiated on a small scale, require relatively limited initial capital investments, and allow for an incremental approach to expanding the recycling infrastructure.

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[29] "The Cost Effectiveness of Yard Debris Recovery," *Resource Recycling*, April 1993.

[30] "Compost Marketing in New England," *BioCycle*, August 1993.

[31] "The Key to a Successful Composting Program," *MSW Management*, 1994.

- There is a strong association between magnitude of capital costs and use of flow control by MRFs. Seven (7) percent of the throughput of low-technology MRFs is supported by flow controls, compared to 32 percent of the throughput of high-technology MRFs.

- In some cases, tipping fees supported by flow controls for mixed waste disposal (e.g., WTE) have provided a funding mechanism for the development and operation of curbside recycling programs and MRFs.

- A majority of recycling facilities are owned and operated by private firms, including about 69 percent of all MRFs, indicating future growth potential because private investors view this market segment as viable.

- An available supply of recyclable materials and a continuing expansion of end-market users (e.g., de-inking facilities) indicate that the recycling segment will continue to account for an increasing share of the MSW management market.

Data Limitations

Appendix III-C presents available data on the amount of waste managed by the recycling segment. EPA obtained d on 1992 recycling of some materials from industry trade associations and updated prior EPA estimates for other materials. resulting total estimate of 40 million tons of recycled MSW plus EPA's estimate of 9 million tons of composted MSW (discussed in Section B) is consistent with *BioCycle's* estimate of 49 million tons of recycled/composted waste in 1992.

Appendix III-C also presents a summary of data on materials recovery by MRFs (which separate commingled recyclables) and MWPFs (which accept mixed waste). Data on MRFs' use of flow controls is derived from information re in Government Advisory Associate's (GAA) *1992-93 Materials Recovery and Recycling Yearbook*. There is no similar source of information on MWPF use of flow controls, although EPA found some anecdotal information in its literat reviews. EPA assumed that recycled materials not recovered at MRFs and MWPFs are recovered by paper and paperboard recyclers ("paper packers") and other recycling centers (e.g., buy-back and drop-off programs). Although data show that controls are used to guarantee recyclable waste flows for an estimated 13 percent of MRFs (19 percent of MRF throughpu some MWPFs, EPA has not found any data that flow controls apply to other recycling subsegments.

C.1 OVERVIEW OF GROWTH TRENDS

Over the past decade, recycling has accounted for an increasingly significant share of the MSW management mark The recycling market segment managed approximately 40 million tons of solid waste in 1992 (as explained in Appendix III-

Recycling of certain commodities (especially paper and paperboard) has long been a significant segment of the MS management market, because recycling often is an economical alternative to disposal. Historical data confirm that percenta changes in recycling over the last two decades generally tracked similar changes in economic growth. The recovery of old newsprint (ONP) and old corrugated cardboard (OCC) illustrates this point. Exhibits III-10 and III-11 compare percentage changes in ONP and OCC recovery, respectively, with percentage changes in gross national product (GNP). A departure f this historical linkage between recycling growth and GNP growth occurred
between 1988 and 1992, when ONP recycling grew at a rapid rate, in spite of a stagnant economy (see Exhibit III-10); ove same period, OCC recycling performed relatively well, compared to earlier periods (Exhibit-III-11).

EXHIBIT III-10

Annual Percentage Change in Old Newsprint (ONP) Recycling and GNP

Contains Data for

Postscript Only.

EXHIBIT III-11

Annual Percentage Change in Old Corrugated Cardboard (OCC) Recycling and GNP

Contains Data for

Postscript Only.

As Exhibit III-12 shows, this growth in newspaper recycling (due to growth in local curbside programs discussed in this section) resulted in ONP prices declining sharply between 1988 and

EXHIBIT III-12

Old Newsprint Prices Paid by End-Users
($/Ton)

Contains Data for

Postscript Only.

1993, due to both increased supply and decreased demand. Aluminum prices also dropped nearly 40 percent in 1991 and h all time low in 1993, primarily due to an influx of aluminum from the former Soviet Union. Despite low prices for some materials collected by curbside programs, recycling has continued to increase in most areas, primarily due to the strong grc government-sponsored recycling programs. Although depressed prices made these recycling programs more costly than e for many communities, prices have rebounded in 1994, making recycling more economically attractive.

The number of curbside recycling programs and MRFs has increased dramatically. This proliferation of curbside programs and MRFs has produced a reliable supply of relatively clean recyclables and has led to an expansion of end-mark For example, the paper and glass industry both have developed an expanded capacity for recycling. These expanded end-n have stabilized some recycled material prices, while communities have developed more efficient collection and processing methods. As a result, many communities now are finding recycling more cost effective than in previous years.

Exhibit III-13 shows that the number of curbside recycling programs reported by *BioCycle* grew by more than 56 percent between 1988 and 1993.[32] The growth in households served by curbside programs may be even greater, because r communities also are expanding the number of households served by existing programs. For example, in 1992, New York added 630,000 housing units to its recycling program. Similar expansions took place in other major cities, such as Philadel Houston, and Los Angeles.[33] Currently, there are more than 6,600 such programs reaching over 101 million people.[34]

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[32] Robert Steuteville, "1994 Nationwide Survey: The State of Garbage in America," *BioCycle*, April 1994.

[33] Robert Steuteville, "Year End Review of Recycling," *BioCycle,* December 1993, page 32.

[34] Robert Steuteville, "1994 Nationwide Survey: The State of Garbage in America," *BioCycle*, April 1994.

EXHIBIT III-13

Reported Growth in Number of Curbside Recycling Programs (1988 to 1993)

Contains Data for

Postscript Only.

Exhibit III-14 illustrates MRF growth between 1985 and 1992, with the most significant development occurring in early 1990s. For example, MRFs showed a record 100 percent growth from 1990 to 1992. For the purpose of this analys definition of a MRF is limited to a facility that sorts and processes *commingled* residential recyclables into marketable raw materials for end-market use. Buy-back and drop-off centers and other recycling facilities that receive source-separated nc commingled recyclables are not considered as MRFs in this Report. According to GAA's biennial survey, 198 MRFs eithe operational or planned to be operational in 1992.[35] (This varies slightly from *BioCycle's* estimate of 192 MRFs in operation in 1992.)[36]

[35] *1992-93 Materials Recovery and Recycling Yearbook: Directory & Guide*, GAA, 1992.

[36] Jim Glenn, "Maturation of Materials Recovery," *BioCycle*, August 1992, page 34.

EXHIBIT III-14

Operational Materials Recovery Facilities (MRFs)
(1985 to 1992)

Contains Data for

Postscript Only.

The growth in curbside programs and MRFs has propelled the remarkable growth in the recycling market segment EPA's *Characterization of Municipal Solid Waste in the United States: 1992 Update* projected that by 1995, 41 million tons of MSW would be recycled.[37] More recent data show that this projection already has been reached, a trends indicate continued growth in recycling. Exhibit III-15 shows this trend line, with recycling accounting for 40 million of the solid waste managed in MSW facilities in 1992. (Appendix III-C provides analytical detail and State-specific estimate recycling.) The paper industry alone anticipates 50 percent recovery by the year 2000 - an increase of 17.4 million tons recovered compared to 1992.

[37] As noted in Appendix III-C, recycling estimates rely on recent industry data to supplement EPA projections.

EXHIBIT III-15

Reported Growth in Recycling Market Segment (1985 to 1992)

Contains Data for

Postscript Only.

C.2 MARKET SUBSEGMENTS

The recycling market segment can be divided into four subsegments:

1. **Material Recovery Facilities (MRFs)**. In 1992, an estimated 198 MRFs were either operational or expected to be operational and to process approximately 5.7 million tons of MSW recyclables. MRFs represent 14.3 percent of the overall recycling market segment. MRFs include low-technology and high-technology operations. About two-thirds of the operational MRFs are low-technology but the waste throughput is divided about 50/50, because high-technology MRFs process twice as much throughput on average. The Northeast region[38] accounted for 43.4 percent of all MRFs and 47.4 percent of all recyclables processed at MRFs. However, the Northeast accounts for less than one-fourth of the total volume of materials recycled. (Appendix III-C provides a detailed State-by-State listing of recycling estimates.) Nineteen (19) States do not have MRFs located within their borders.[39] This indicates that competition from MRFs in the Northeast may have reduced the amount of recycling by other market subsegments in that region.

2. **Mixed Waste Processing Facilities (MWPFs)**. MWPFs accept mixed waste (just as mixed waste would be received at a landfill or WTE facility) in order to separate out recyclable

[38] Northeast States include Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, and Vermont.

[39] States that had no MRFs in 1992 include: Alaska, Arkansas, Colorado, Hawaii, Idaho, Indiana, Kansas, Kentucky, Mississippi, Montana, Nebraska, New Mexico, North Dakota, Oklahoma, Oregon, South Dakota, Utah, West Virginia, and Wyoming.

materials. Due to higher degrees of contamination, such recyclables may not appeal to the same end-markets as materials from MRFs. This subsegment was in the nascent stage of development in 1992 and consequently recovered only 300,000 tons of recyclables, constituting less than 1 percent of the recycling market. Twenty-one (21) MWPFs either were planned or operational that year.

3. **Paper Packers**. Independent recovered paper and paperboard dealers, recycling centers, or processors (commonly referred to collectively as "paper packers") receive paper and paperboard that generally is source-separated by material type (e.g., used corrugated from large commercial sources). The American Forest and Paper Association (AFPA) estimates that there are 600 recovered paper dealers in the U.S.[40] As of 1992, AFPA directories identified paper dealers in all but 11 States and the District of Columbia. In addition, some of the major paper manufacturers, such as Weyerhauser and Stone Container, have paper collection and brokerage divisions.[41] Paper packers recycled approximately 25 million tons of paper and paperboard in 1992, accounting for 62.5 percent of the overall recycling market. (Newspapers processed by MRFs are not included in these figures.)

4. **Other Recycling Centers**. EPA defines this subsegment to include any recycled materials facilities not included in other subsegments. These facilities generally receive materials directly from consumers or via agreements with municipalities. In 1992, approximately 9 million tons of recyclables were recovered through a combination of industry-sponsored buy-back programs and drop-off centers (e.g., for glass, plastic, and metal containers). For example, the aluminum industry alone has over 10,000 industry-sponsored buy-back locations and agreements with more than 4,000 municipal curbside programs.[42] EPA estimates that most aluminum (used beverage cans) is recovered through these buy-backs, since the analysis of MRFs reveals that less than one half of all aluminum recovered comes through MRFs.

Exhibit III-16 illustrates the amount of waste recycled by these four market subsegments.

EXHIBIT III-16

Recycling Market Subsegments
(1992 tons)

[40] PaperMatcher: A Directory of Paper Recycling Resources, American Forest Products Association, July 1992.

[41] Ronald Kopicki, Leslie Legg, and Michael Berg, Reuse and Recycling - Reverse Logistics Opportunities, Council of Logistics Management, 1993, page 91.

[42] Can Manufacturers Institute, "Turn Aluminum Cans into Cash: A Recycling and Fundraising Guide," 1993.

Contains Data for

Postscript Only.

C.3 MARKET SEGMENT COMPETITIVE STRUCTURE

The growth in the recycling market segment is driven by at least six separate factors:

(1) Forty-three (43) States and the District of Columbia have recycling and/or source reduction laws or goals and landfill bans on certain recyclable materials;

(2) Even in the absence of such laws, recycling can be an economical alternative to landfill disposal and waste combustion;

(3) Recycling programs often can operate efficiently on a relatively small scale, allowing for the expansion of recycling activity without the risk of substantial capital investments for new facilities;

(4) The private sector is heavily involved with recycling. A major portion of recycled materials goes directly to the private sector. This especially is true in the case of paper recycling. Private sector paper packers accounted for 62.5 percent (25 million tons) of the recycling market in 1992;

(5) There is an expanding infrastructure of privately owned capacity for providing MRF facility design, operation, and management services for local governments that do not wish to own and/or operate their own facilities; and

(6) Data show that flow controls play a smaller role for low-technology MRFs (7 percent) and a larger role for high-technology MRFs (32 percent); most of the MRFs supported by flow controls are located in the Northeast.

Recycling Laws and Landfill/WTE Bans

Recycling Laws. Forty-three (43) States and the District of Columbia have adopted recycling laws/goals.[43] These laws include provisions such as recycling goals for State or local governments, recycled-content legislation, curbside collec requirements, commercial recycling requirements, and general mandates to establish recycling programs. Over the past de these laws have fostered rapid expansion of the infrastructure for collecting and processing recyclables. Also, the demonst commitment of State and local governments to recycling has encouraged industries to invest in infrastructure to respond to increased supply of recyclables and the increased demand for goods made from recyclables. For example, in 1992, 27 mill North America had the capacity to de-ink recovered newsprint, up from just 9 mills in 1989. AFPA estimated 13 new newsprint de-inking mills or expansions slated for 1993-1995 with an increased de-inking capacity of nearly 1.5 million tons annually.[44] Additional industry investments also may result from State and federal procurement requirements for minimum recycled content.

Landfill and WTE Bans. As mentioned in the previous section on composting, 27 States currently have yard trimm disposal bans. These States and others also have begun to ban certain other materials from solid waste landfills and WTE facilities. Prohibited wastes include such items as lead-acid batteries, tires, used oil, small batteries, and appliances. Other States have extended landfill bans to paper and various forms of packaging. For example, Wisconsin bans the disposal of r paper and packaging materials, unless the community has a State-certified recycling program. These bans generally were e in order to foster recycling and typically place the recycling burden on waste generators and haulers, rather than product manufacturers.

Competitive Economics

This subsection examines available data only on MRF processing costs and the costs of curbside collection progra Cost data for other recycling subsegments generally are unavailable. MRF processing costs include the relatively significar of separating commingled recyclables. By contrast, other recycling subsegments incur lower costs since they generally rec source-separation by material type (e.g., separation of OCC and ONP for paper recyclers, and separate bins for glass, alum and other containers received at drop-off and buy-back centers).

Exhibit III-17 presents estimates of average material collection and processing costs. These estimates are drawn f number of sources and provide an indication of potential costs. Many variables contribute to the costs of MSW programs. with most commodities, regional variations in

EXHIBIT III-17

Average Estimated Collection and Materials Recovery Facilities (MRFs) Processing Costs

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[43] Robert Steuteville, "The State of Garbage in America: Part II," *BioCycle*, May 1994, pp. 30-36. Of the 43 States, 36 States specifically adopted statutes with recycling and/or source reduction goals. The other 7 States adopted goals through different means, such as executive orders by State governors.

[44] American Forest and Paper Association, Economics and Materials Department, "Recovered Paper De-inking Facilities," September 1993.

($ per ton)

Material	Collection Costs[1] (A)	MRF Processing Costs (B)	Revenue[2] (C)	Net Cost Per Ton [A+B]-C	Percent of Total MSW Collected[3]
Newspaper (ONP)	$72	$34	$17	$88	60
Glass[4]	$60	$73	$51	$82	27
Aluminum	$581	$143	$609	$116	2
Steel	$240	$68	$65	$242	8
Plastic[5]	$1,089	$184	$137	$1,136	3
Weighted Average Collection and Processing Costs				$131	

Sources: National Solid Wastes Management Association (NSWMA), *The Cost to Recycle at a Materials Recovery Facility*, 1992; NSWMA, *The Cost of Recycling*, 1993; and analysis of data from Governmental Advisory Associates.

Notes:

1. Costs per ton are much lower for dense, heavy materials, like ONP and glass, because a single truck can collect a higher tonnage. Collection costs assume a 50 percent set out rate for curbside collection.
2. Average 1993 prices paid by end-users as reported in "Year in Markets," *Recycling Times*, December 28, 1993. End-user prices may include transportation to the buyer of the recycled materials, and thus may overestimate net revenue.
3. Percentage based on materials processed at MRFs operational in 1992. Mixed containers reallocated to glass and plastic according to percentages reported by NSWMA.
4. Glass costs represent clear glass only.
5. Plastic costs represent PET only.

prices (i.e., revenues) can be significant in affecting net costs. Exhibit III-17 shows that the net cost per ton can vary grea different recyclable materials; this means that community costs will be affected by the relative mix of recyclables collected, among other factors.

Exhibit III-18 presents sample MRF cost data for eight cities with MSW curbside collection and processing progra including data on mixed waste collection and landfill disposal for four of these cities. The weighted average cost shown in III-17 ($131 per ton) is within the range of both recycling and mixed waste disposal costs provided for the programs cover Exhibit III-18, which suggests that recycling costs may now be cost-competitive with mixed waste disposal in many communities. Net recycling costs for the surveyed programs range from $90 per ton to $168 per ton, because costs deper many factors, such as program design, labor costs, and collection routes. Unfortunately, there is little comparative data ava

In addition, a recent survey of the costs of 17 curbside collection programs showed collection costs ranging from per ton to $263 per ton, with a weighted average cost of $138 per ton.[45] This estimate is within the range shown in Exhibi 18; this survey did not compile information on the costs associated with processing of recyclables.

Exhibit III-18 shows that net recycling costs for the surveyed programs range from $90 per ton to $168 per ton. range is attributable to the unique nature of each program, for example:

- Regional markets for recyclables offer revenues from $0 to $41 per ton;
- Collection costs vary with the set-out rate, population and demographics, and crew size, among other variables; and
- The mix of materials significantly affects all recycling costs (see Exhibit III-17).

[45] Steve Apotheker, "Curbside Recycling Collection Trends in the 40 Largest Cities," *Resource Recycling*, December 1993.

EXHIBIT III-18
Overview of Curbside Collection and Processing Costs from Eight City Sample

City	Recycling Costs ($ per Ton)				Disposal Costs ($ per Ton)				Recycling Net Savings over Disposal ($ per Ton) (I)
	Collection Costs (A)	Processing Costs (B)	Revenue (C)	Net Cost D=[A+B]-C	Collection (E)	Transfer/ Disposal (F)	Revenue (G)	Net Cost (H)=[E+F]-G	
Sample 1[a]									
1	91.00	25.00	0.00	116.00	90.00	71.00	0.00	181.00	65.00
2[1]	89.00	42.00	41.00	90.00	67.00	70.00	0.00	137.00	47.00
3	191.00	0.00[2]	23.00	168.00	56.00	112.00	10.00[3]	158.00	-10.00
4	137.00	0.00	6.00[4]	131.00	85.00	71.00	0.00	156.00	25.00
Sample 2[b]									
A	112.78[5]	40.00	28.60	124.18	N/A	N/A	N/A	N/A	N/A
B	123.00[5]	42.00	27.60	137.40	N/A	N/A	N/A	N/A	N/A
C	115.38	24.00	30.00	109.38	N/A	N/A	N/A	N/A	N/A
D	110.26	26.03	38.45	97.84	N/A	N/A	N/A	N/A	N/A

Sources:
a. Clean Washington Center, *The Economics of Recycling and Recycled Materials*, December 1993. Represents different cities in Washington.
b. Lynn Scarlet, "Recycling Costs: Clearing Away Some Smoke," *Solid Waste and Power*, July/ August 1993. Represents different cities in California.

Notes:
1. MRF processing included in overall recycling program.
2. Recyclables are sorted by material type during collection and delivered directly to private processors; thus, processing costs are included in collection costs.
3. City earned "disposal" revenues from electricity sales to a power company.
4. Materials delivered to private processor for total revenue (over cost) averaging $6.00.
5. Collection figures exclude public department costs (e.g., education, public employee salaries), thus understating total costs by approximately $1.00 to $5.00 per ton.

Capital Requirements and Scale of Operations

The explosive growth in the MRF market over the past few years has shown that the lag time from planning to operational status for these facilities is relatively short. MRF development does not face the same public opposition or complicated and time-consuming processes that affect the siting and building of other waste management options, such as combustors and landfills. However, MRFs may entail significant capital costs, as summarized in Exhibit III-19[46] for 134 M for which data are available.

EXHIBIT III-19

Average Capital Costs of Materials Recovery Facilities (MRFs)

High Technology MRFs	$4,797,292
Low Technology MRFs	$1,920,810
Weighted Average	$2,951,192

Exhibit III-20 represents the weighted average and median costs and design capacity calculated for the 198 MRFs estimated to be in operation in 1992. The median capital costs per ton are somewhat higher than the average costs per ton, indicating that larger MRFs realize some economies of scale. This may explain why 71 percent of planned facilities will be high-technology, large scale plants with higher total capital costs bu lower capital costs per ton of capacity than existing facilities.[47]

EXHIBIT III-20

Median and Weighted Average Cost and Design Capacity of Materials Recovery Facilities

Type Of Cost	Median	Weighted Average
Operating Cost/Ton	$36	$36
Capital Cost/Per Ton Per Day of Capacity	$33,853	$24,732
Design Capacity (tpd)	75	117

Most MRFs charge tipping fees far below the operating costs shown above and more than half charge no tipping fees or even pay for materials received; this indicates that the MRF subsegment is highly competitive. MRFs depend on the fluctu markets for recyclables to earn revenues to cover their costs.

Public/Private Infrastructure

[46] Database compiled from 1992-3 Materials Recovery and Recycling Yearbook: Directory and Guide, Governmental Advisory Associates, 1992.

[47] Ibid. Only 30 percent of operational and "shake-down" facilities are high-technology MRFs.

Analysis of MRFs operating or expected to be operating in 1992 indicates that the majority of MRFs were privately owned and operated:

- 69 percent were privately owned and operated;
- 17 percent were publicly owned facilities operated by the private sector; and
- 14 percent (primarily in the Northeast) were publicly owned and operated facilities.

A relatively small proportion (9 percent) of privately owned and operated MRFs are supported by flow controls; in comparison, flow controls support 25 percent of publicly owned and operated MRFs and 21 percent of publicly-owned anc privately-operated MRFs.[48] (See Exhibit C.8 in Appendix III-C.)

The five largest private MRF firms represent approximately 50 percent of MRF processing capacity.[49] Three of th firms operate 30 sorting plants for commingled residential recyclables, which represent a combined capacity of 7,500 tons day, and generate more than $55 million in annual revenues.[50] The other two firms each operate between 20 and 30 commi sorting plants in conjunction with their waste hauling services. All of these firms saw vastly increased growth in the early The growth in the MRF subsegment is beginning to level off to a more moderate rate of increase. Although the growth in t number of MRFs coming on-line is slowing, newer MRFs have larger capacities and often are owned by integrated compar

Flow Control Role in Recycling Growth

Available data suggest that flow controls pertain to the MRF subsegment only. Although many States that authoriz flow controls for mixed waste exclude recyclables from flow control restrictions, Exhibit III-21 shows that approximately percent of MRFs (19 percent of MRF throughput) are supported by flow controls. Based on data from the GAA *Yearbook* EPA estimates

EXHIBIT III-21
Use of Flow Controls by Materials Recovery Facilities in 1992

	#	%	Throughput	%
Flow Control	26	13%	1,081,587	19%
Contract	82	41%	2,491,170	44%
Neither	79	40%	2,034,156	36%

48 Ibid.

49 Jerry Powell, "Materials Recovery Facilities: Who are the big actors and what are they up to?" *Resource Recycling*, October 1993, page 47.

50 Ibid, page 48.

N/A	11	6%	97,068	2%
Total	198		5,703,981	

that about 2.7 percent (i.e., about 1.1 million tons) of the 40 million tons of waste recycled is subject to flow controls, as s in the following exhibit.

Flow controls have been more important for high-technology MRFs than for low-technology MRFs. Exhibit III-2 shows that flow controls support 32 percent of throughput in high-technology MRFs, compared to only seven percent of throughput in low-technology MRFs. Another 24 MRFs are planned to be operational after 1992; the trend is for relatively greater development of high-technology MRFs (i.e., 17 of out of 24) with six facilities to be supported by flow controls. F seven low-technology MRFs that are planned to be operational after 1992, only one is expected to be supported by flow controls. (See Exhibit C.10 in Appendix III-C.)

EXHIBIT III-22

Use of Flow Controls by High-Technology and Low-Technology Materials Recovery Facilities (MRFs) in 1992

	High-Technology MRFs			Low-Technology MRFs		
	#	Throughput	%	#	Throughput	%
Flow Control	17	890,426	32%	9	191,161	7%
Contract	29	1,414,590	50%	53	1,076,580	37%
Neither	14	492,868	18%	65	1,540,288	53%
N/A	1	20,222	1%	10	76,864	3%
Total	61	2,819,106		137	2,884,893	

As shown in Exhibit III-23, there is a strong association between the capital costs of MRFs and their support by fl control. Regardless of whether a MRF is high-technology or low-technology, facilities supported by flow controls have hi capital costs on average than MRFs not

EXHIBIT III-23

Capital Costs and Use of Flow Controls by Materials Recovery Facilities (MRFs) in 1992

	High-Technology MRFs		Low-Technology MRFs	
	#	Average Capital Costs	#	Average Capital Cost
Flow Control	13	$6,788,462	8	$3,256,250
Contract	26	4,605,769	46	1,255,602
Neither	9	2,474,444	36	2,035,889
N/A	0	0	4	2,022,500
Total	48	4,797,292	86	1,920,810

Note: Only 134 of the 198 MRFs reported capital costs; of these 134, all but 4 provided data on use of waste guarantees (e.g., flow controls). Only 21 of the 26 MRFs supported by flow controls reported capital cost information.

supported by flow controls. The difference in use of flow controls by high-technology and low-technology MRFs reflects greater capital costs of the former ($4.8 million on average) compared to the latter ($1.9 million on average). (See Exhibit

To date, the use of flow control to support MRFs has been concentrated in the northeast. Exhibit III-24 shows th percent (20 out of 26) of the MRFs supported by flow controls, with a corresponding 86 percent of the MRF throughput supported by flow controls, are located in the Northeast. Nineteen (19) States have no MRF facilities at all.

EXHIBIT III-24
Use of Flow Controls by Materials Recovery Facilities in the Northeast
(n = 86 of 198)

	High-Technology		Low-Technology		Total	
	# Facilities	Throughput (tons)	# Facilities	Throughput (tons)	# Facilities	Throughput (tons)
Flow Control	13	764,680	7	163,661	20	928,341
Contract	19	795,716	17	334,991	36	1,130,707
Neither	8	321,451	21	338,433	29	659,884
N/A	1	20,222	0	0	1	20,222
Total	41	1,902,069	45	837,085	86	2,739,154

In addition to throughput supported by flow controls, a significant amount of MRF throughput is guaranteed throu contractual arrangements. The contractual arrangements may, but need not, be supported by some form of municipal con over waste disposition: the municipality may either collect the waste itself, contract out for collection, use franchises to co the ultimate destination of waste collected, and/or enact a flow control ordinance. For example, a local government under to provide waste to a privately-owned MRF may use a flow control ordinance to ensure that enough waste is delivered to n the terms of the contract. As a result, some of the waste guaranteed by contracts also may be backed by local governmen flow controls; however, data are not available to assess how often this situation occurs.

Flow controls on mixed waste disposal facilities (e.g., WTEs) also may have an impact on recycling by allowing S and local governments to increase tipping fees above market levels. These higher tipping fees can make recycling more co competitive with mixed waste disposal and can provide a funding mechanism to subsidize curbside recycling programs and recycling promotion and education programs. Data describing the extent and magnitude of such use of flow controls is no available.

At EPA's public hearings on flow control, many local governments indicated that recycling subsidies, resulting fro tipping fees supported by flow controls, played an important role in developing curbside collection programs and MRF infrastructure over the past few years. During this time, cost-effective residential recycling methods generally were in a developmental stage; economic conditions limited end-market demand; and many communities incurred significant "start-up" costs for recycling programs, including public education costs to raise recycling participation rates.

C.4 MARKET SEGMENT POTENTIAL

The potential size of the MSW recycling market segment is subject to two constraints: (1) the supply of recyclable MSW; and, (2) the end-market demand for recyclables.

Supply of MSW Recyclables

The major recyclable MSW materials are paper and paperboard, glass, plastics, metals, textiles and wood. Exhibit III-25 presents 1992 generation estimates for these recyclables (see Appendix III-A) and the current amount of each recovered (see Appendix III-C). The improving economics of recycling and the ample supply of recyclable MSW should support continuing growth in the recovery of recyclable MSW.

EXHIBIT III-25

Current Supply and Recovery of EPA-Defined Municipal Solid Waste (million tons)

Material Type	1992 Generation	1992 Recovery
Paper and paperboard	75.3	29.1
Glass	13.5	4.15
Plastic	16.6	.65
Metals	16.6	3.8
Textiles, wood, and other waste (appliances, batteries)	24.8	2.3
Total Recyclable	**146.8**	**40.0**

CHAPTER III